Determining Risks For Hazardous Material Operations

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Abstract

Integrated Safety Management (ISM) is structured to manage and control work at the activity level. Fundamental to ISM is that all work will be performed safely while meeting the applicable institutional-, facility-, and activity-level expectations. These expectations are met using the Safe Work Practices (SWPs) work-control process and are documented in Hazard Control Plans. High and medium initial risk activities require certain levels of peer and/or subject matter expert reviews prior to authorization. Division-level line management authorizes operations with medium residual risks, while lower risk activities can be authorized at commensurably lower management levels. A key responsibility of line management is to assign initial and residual risk adequately, so that the proper reviews and authorizations are obtained. In the following report, a Risk Determination Matrix (RDM) is presented for all physical, health and ecological hazards associated with materials. Institutional requirements validate the risk assessment. This RDM will promote conformity and consistency in the assignment of risk to hazardous material activities.

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Introduction

- Integrated Safety Management (ISM)
- Safe Work Practices (SWPs)
- Hazard Control Plans (HCPs)
- Risk Assignment

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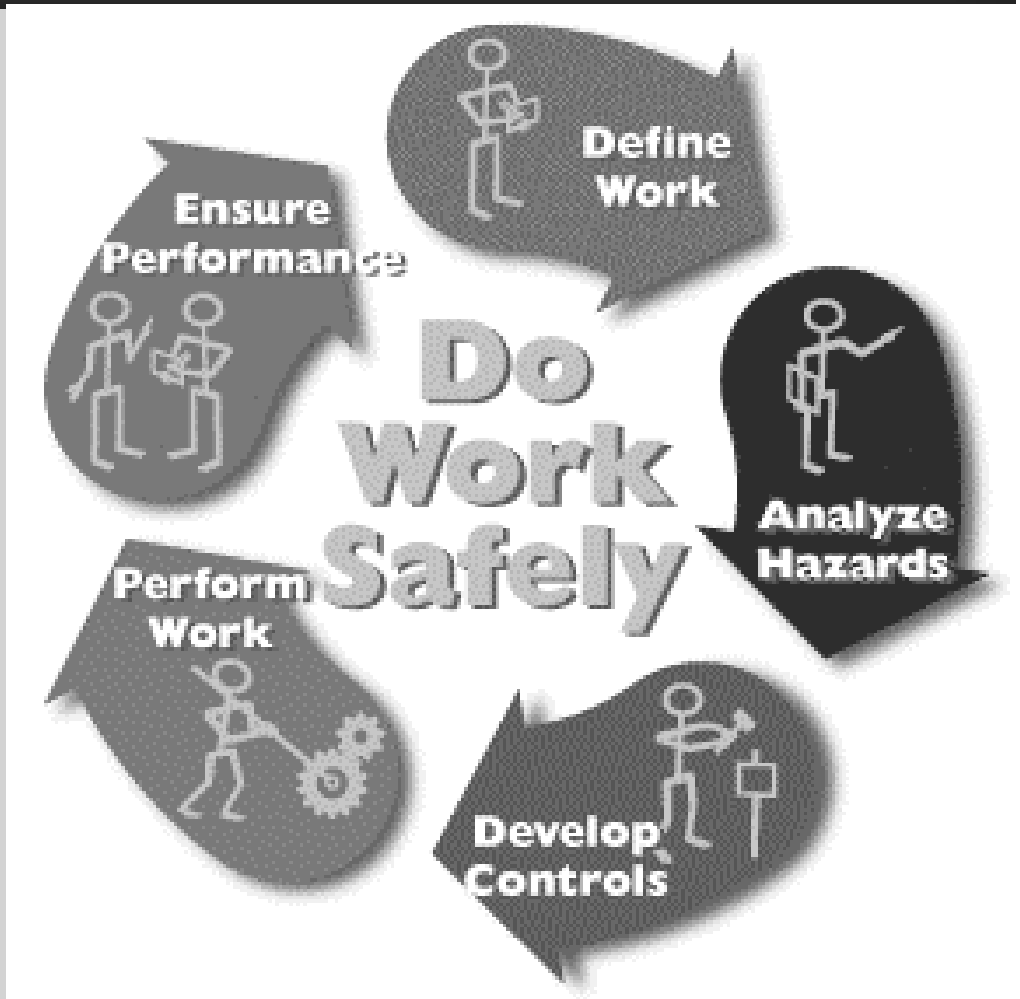
Introduction

- The quality of the ISM system is dependent upon risk determination.
- Line management is responsible for this task.



Level of Review

Initial Risk Level	Review Required
High	Concurrence of ES&H SME & Independent peer
Medium	Consultation with ES&H SME and/or Independent peer
Low or Minimal	None

ESH SME – Industrial Hygienist

- Possesses B.S. in Biology, Chemistry, Engineering, or other Basic Sciences
- Obtained Graduate Degrees in Industrial Hygiene or Related Fields
- Uses Monitoring Techniques to Evaluate the Exposures Associated with the Materials Handled in the Process.

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Independent Peer – Chemical Hygiene Officer

- Has Sufficient Technical Knowledge of an Activity
  - To Understand the Potential Hazards
  - To Understand the Methods By Which Those Hazards Can Be Mitigated

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Level of Authorization

Risidual Risk Level	Authorization Required
High	Work will not be authorized or performed
Medium	Division Director
Low	Group Leader
Minimal	Supervisor

Risk Model

- How can this material cause harm?
- How likely is it that this material will cause an accident?
- How much harm can the accident cause?
- Is this degree of harm acceptable?

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Risk & Likelihood

- Risk = Likelihood · Potential Severity
- Likelihood = *f* (Exposure)

Exposure: Physical Hazards

- Quantity of the material
- Incompatibility with other materials
- Appropriate conditions for the hazard to be realized
- Magnitude or level of exposure
- Frequency of exposure

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Exposure: Health Hazards

- The route of exposure
- Duration of each and all exposures
- Genetic parameters
- Dietary status and condition
- Concurrent exposures
- Differences between individuals being exposed

Magnitude of Exposure Adjustments

Operation	Modification Factor
Storage (stock solutions)	0.01
Very simple wet operations	0.10
Normal Operations	1.00
Complex wet operations with risk of spills	10.00
Dry operations	10.00
Dry and dusty operations	100.00

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Frequency

	Frequency of Use			
Quantity (gm)	**Daily**	**Weekly**	**Monthly**	**Yearly**
> 1000	HIGH	HIGH	MODERATE	LOW
100 - 1000	HIGH	MODERATE	LOW	LOW
< 100	MODERATE	LOW	LOW	LOW

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Duration

frequency Results	> 10	6 - 10	2 - 6	1 - 2	< 1
High	FREQUENT	FREQUENT	PROBABLE	OCCASIONAL	IMPROBABLE
Moderate	FREQUENT	PROBABLE	OCCASIONAL	IMPROBABLE	REMOTE
Low	PROBABLE	OCCASIONAL	IMPROBABLE	REMOTE	REMOTE

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Physical Hazards

- Combustible Liquids
- Compressed Gases
- Cryogens
- Explosive Materials
- Flammable Materials
- Oxidizers
- Organic Peroxides
- Pyrophoric Materials
- Asphyxiates (Simple)
- Reactive Materials
- Water Reactive Materials

Health Hazards

- Carcinogens
- Chemical Asphyxiates
- Target Organs Toxins
- Corrosives
- Irritants
- Reproductive Toxins
- Sensitizers
- Toxins
- Poisons (Highly Toxic)

Environmental Hazards

- RCRA
- CWA
- CAA

Severity: Acute

Health Hazard	Moderate	Critical	Catastrophic
Irritants	X		
Corrosives		X	
Chemical Asphyxiates		X	
Sensitizers			X
Poisons - Acute			X

Severity: Chronic

Health Hazard	Moderate	Critical	Catastrophic
Toxins	X		
Target Organs	X		
Poisons		X	
Carcinogens		X	
Repro		X	
Select Poisons			X
Carcinogens - Human			X
Repro - Human			X

Severity: Fluids

Physical Hazard	Moderate	Critical	Catastrophic
Simple Asphyxiates	X		
Compressed Gases		X	
Cryogens			X

Severity: Reactive Materials

Physical Hazard	Moderate	Critical	Catastrophic
Reactive	X		
Heat Sensitive		X	
Shock Sensitive		X	
Water Reactive		X	
Explosive			X
Peroxide Former			X

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Severity: Flammable Materials

Physical Hazard	Moderate	Critical	Catastrophic
Reactive	X		
Heat Sensitive		X	
Shock Sensitive		X	
Water Reactive		X	
Explosive			X
Peroxide Former			X

Severity: Environment

Environmental Hazard	Moderate
RCRA	X
CWA	X
CAA	X

Validation

- The levels of severity for flammability, reactivity, and acute health hazards can be compared to the values of the NFPA 704M system.
- Poisons classifications can be compared against DOT classifications

Risk Determination

	Likelihood				
Severity	**Frequent**	**Probable**	**Occasional**	**Improbable**	**Remote**
Catastrophic	High	High	High	Medium	Low
Critical	High	High	Medium	Low	Minimal
Moderate	High	Medium	Low	Minimal	Minimal
Negligible	Low	Minimal	Minimal	Minimal	Minimal

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Residual Risk Factors

Five Categories of Control

- Elimination
- Substitution
- Engineering controls
- Administrative controls
- Personal Protective Equipment (PPE)

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Commercially Available Software

Chemistry ChemSW®
Software for Windows®

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Institutional Databases

- Chemical inventory tracking system
- Substance identification data system
- Training tracking system
- Authorization tracking system
- Document control tracking system
- Issues tracking system

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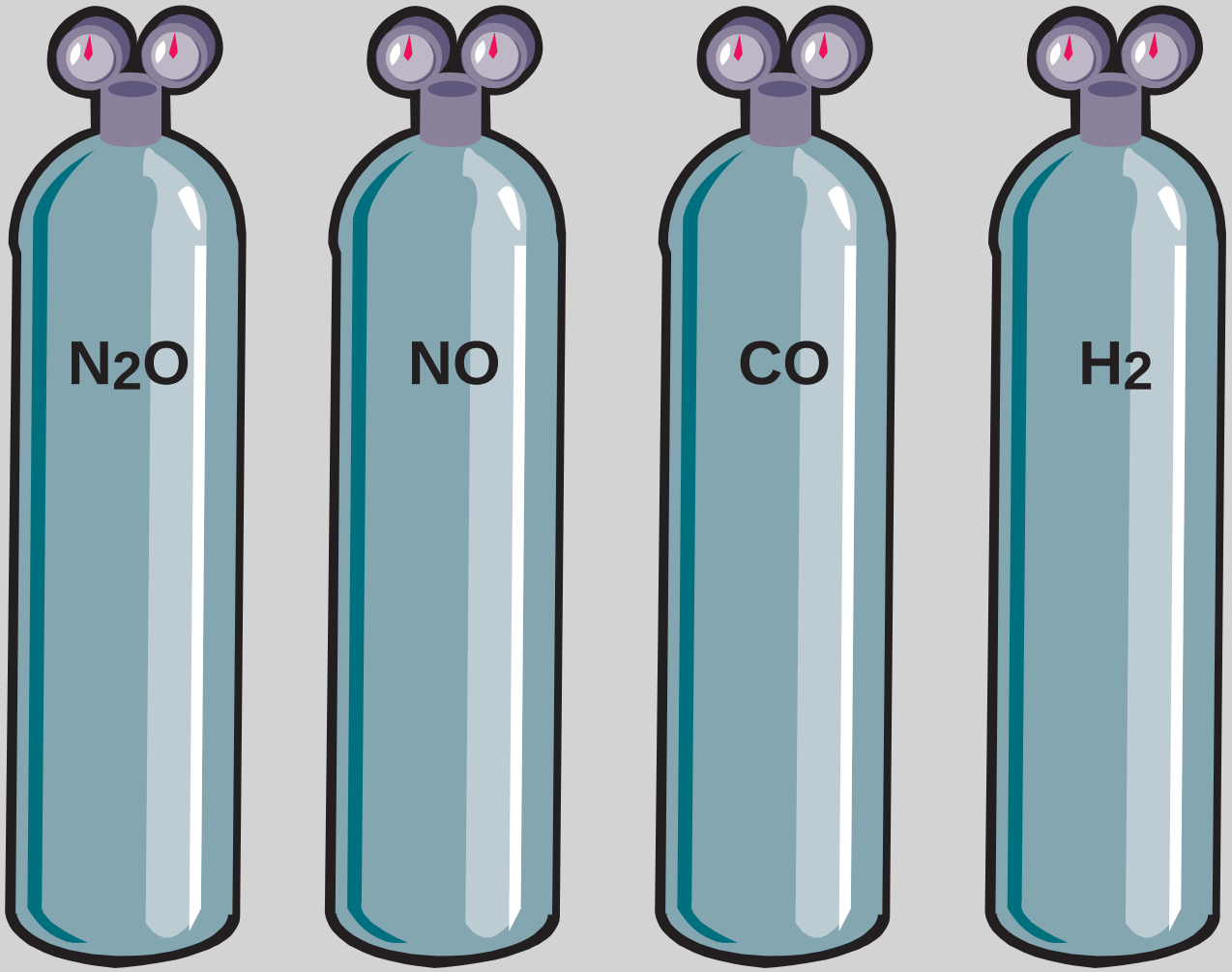
Input

- CAS No.
- Quantity (gm)
- Concentration (%)
- Frequency, Duration, Type of Operation

Case Study #1: Gas Cylinder Storage



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Case Study #1: Gas Cylinder Storage

Hazard	N_2O	NO	CO	H_2
Stored Energy	X	X	X	X
Flammables			X	X
Oxidizers	X	X		
Simple Asphyxiant	X	X	X	X
Toxic		X	X	
Repro - Human			X	
Chemical Asphyxiant		X	X	

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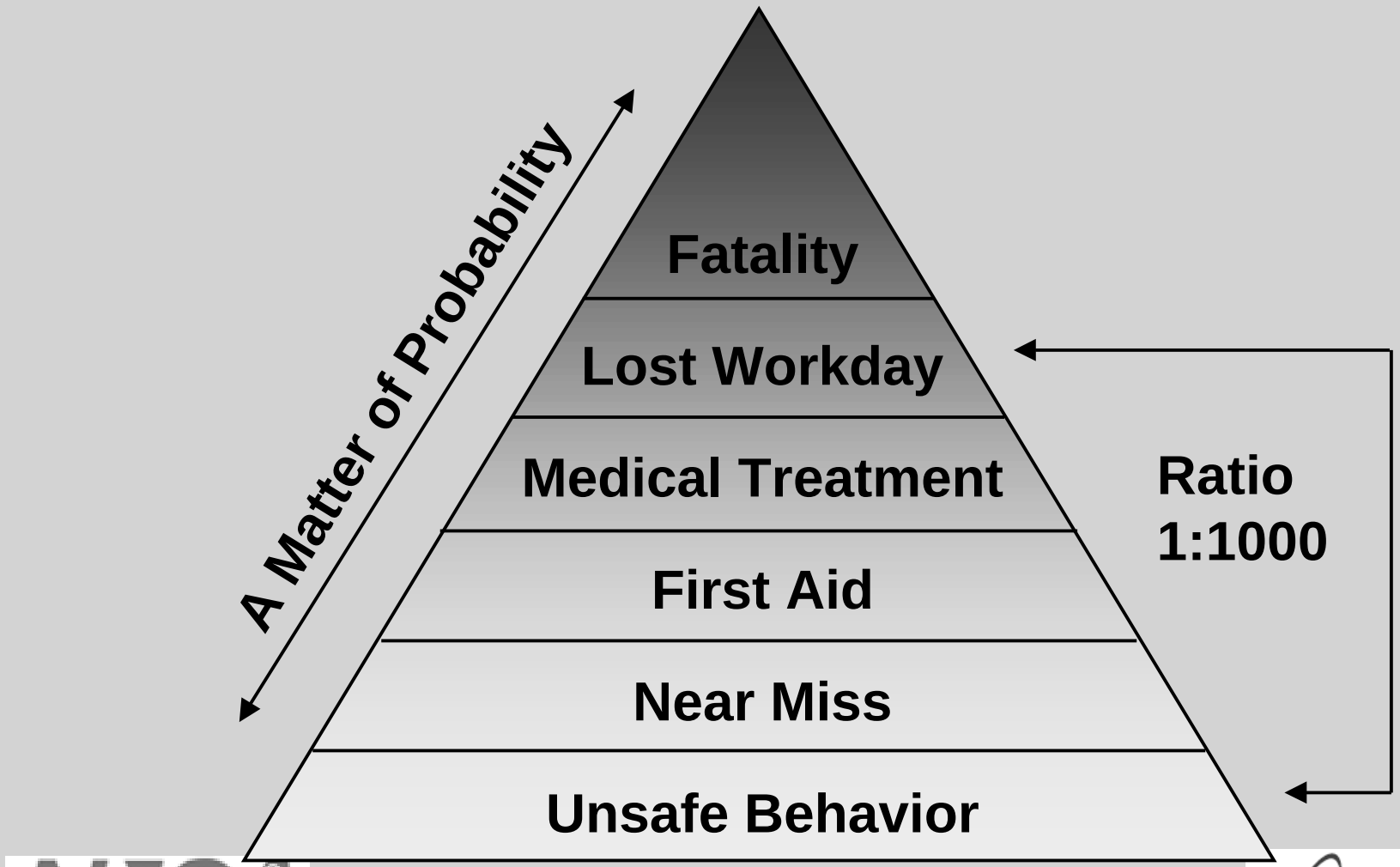
Case Study #1: Gas Cylinder Storage

Level	Initial Risk	Residual Risk
High	X	
Medium		
Low		X
Minimal		

Case Study #1: Gas Cylinder Storage

- π to the 23st decimal is 3.14159265358979323846264

Performance Metric



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Discussion - Complexity

- Determining risk associated with hazardous materials is an exercise in complexity.
- To meet these requirements is only a simple matter of managing hazardous materials.

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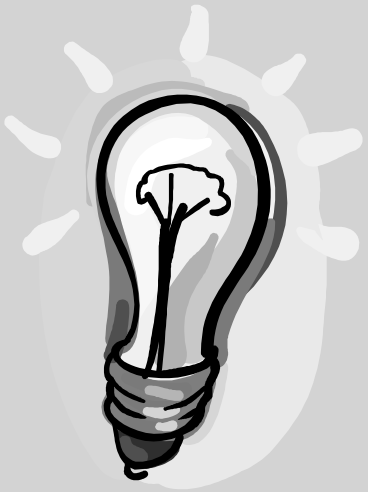
Discussion - Knowledge is Power



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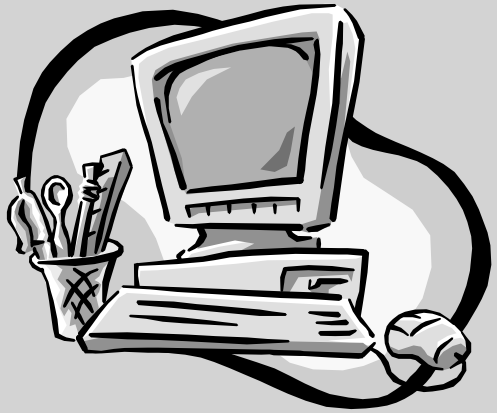

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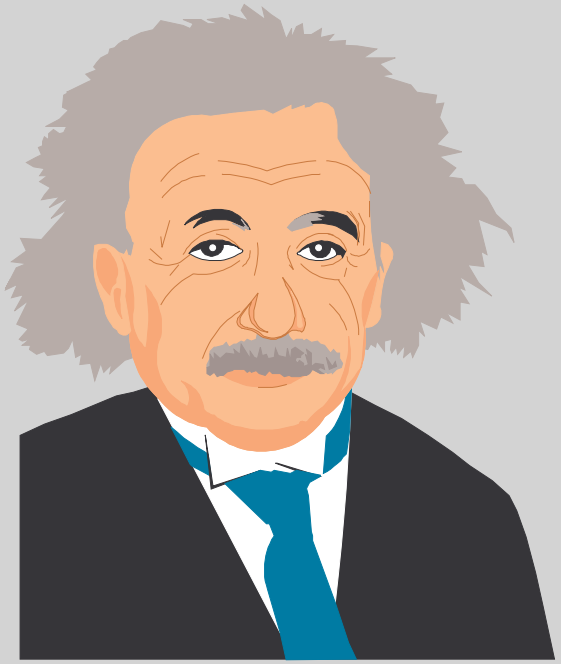
Discussion - Quote of the Day

Albert Einstein (1879 - 1955)

- “Imagination is more important than knowledge.”



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Conclusions

- Risk determination, while simple is by no means easy.
- Only through the use of computers is this exercise in complexity manageable.
- Tapping into the institutional database provides a way to take advantage of the combined expertise of the institution.
- In summary, by using this Risk Determine Model, line management can promote conformity and consistency in the assignment of risk to hazardous material activities.

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